Introduction to Image Classification using Convolutional Neural Networks (CNNs)

Module 6 - Vision Models

Agenda

- Inspiration from Nature
- Overview of CNNs
- Key Concepts:
  - Convolution
  - Filters/Kernels
  - Activation Functions
    - Swish Activation Function
  - Pooling Layers
- Image Classification Use Cases
- Advanced Topics Preview
- Q&A Session

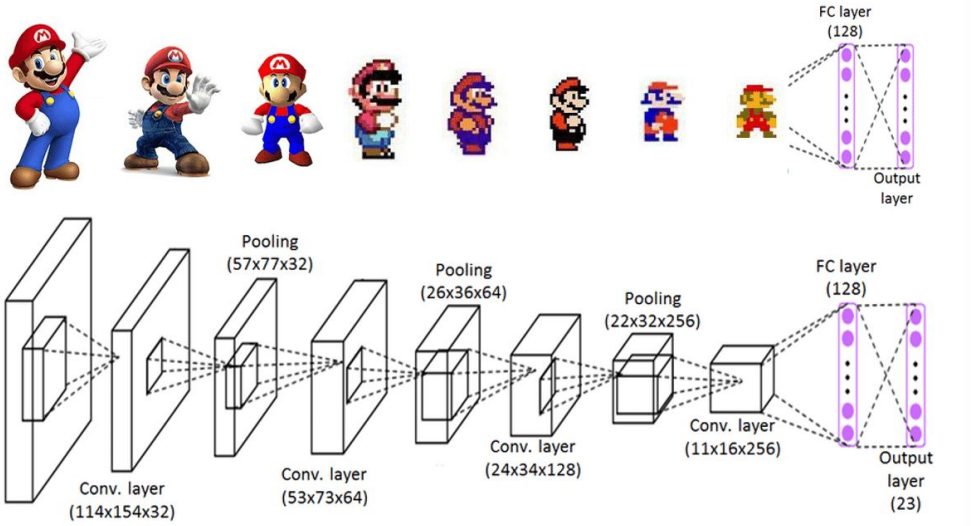


Image source: [Inlyse Blog]

Inspiration from Nature

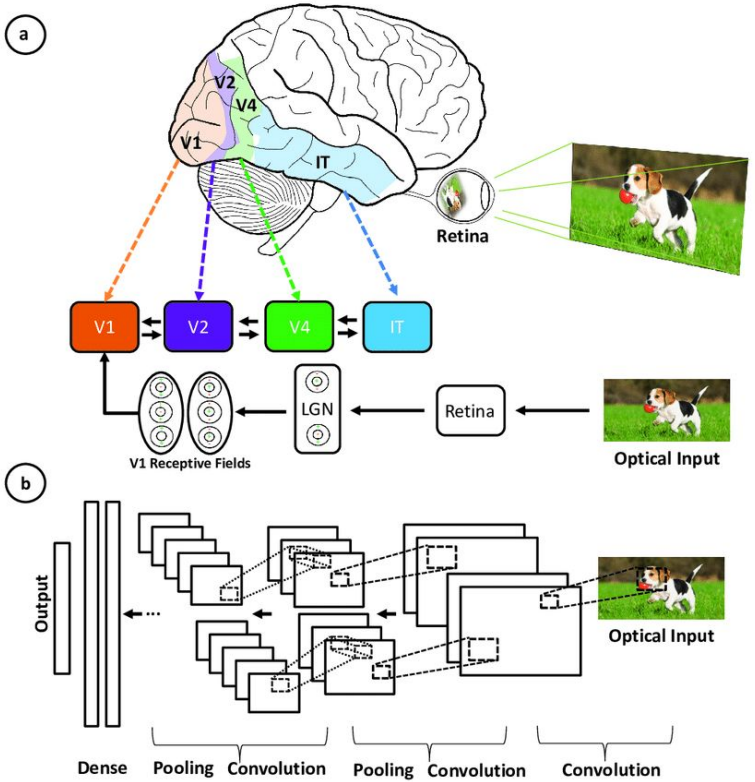


Image source: [Ranking to Learn and Learning to Rank: On the Role of Ranking in Pattern Recognition Applications]

Introduction to CNNs

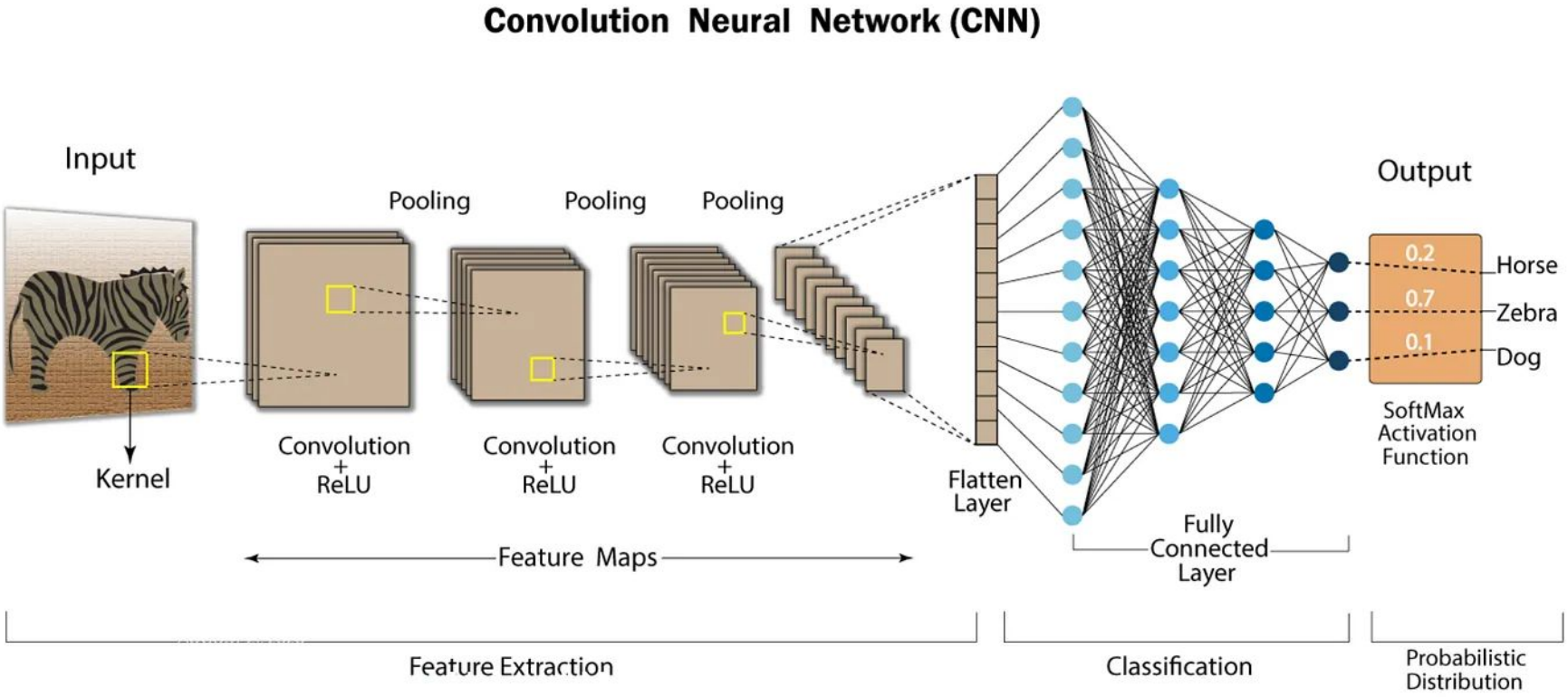


Image source: [Medium]

Traditional vs. CNN Approach

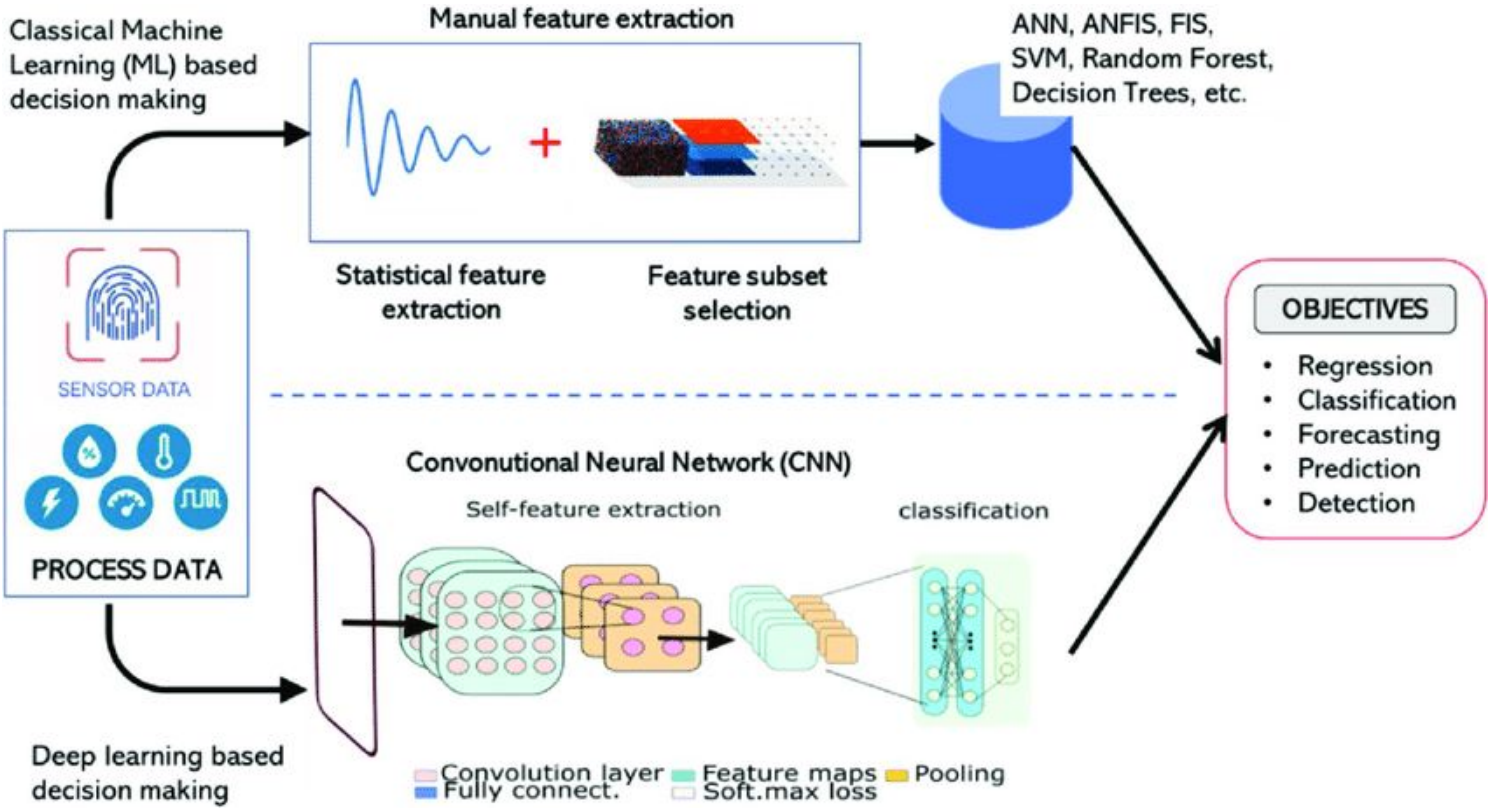


Image source: [Modelling and monitoring of abrasive finishing processes using artificial intelligence techniques: A review]

CNN Architecture Overview

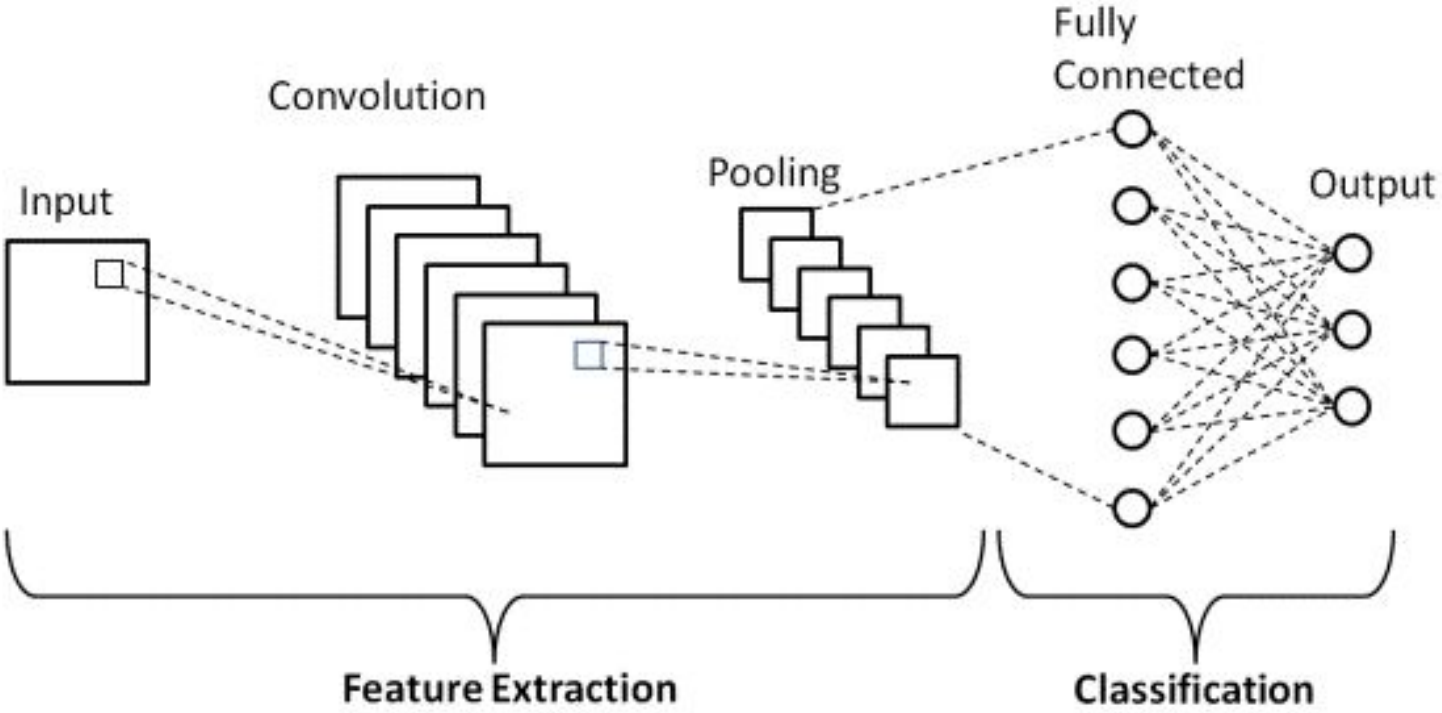


Image source: Medium

Convolution Operation

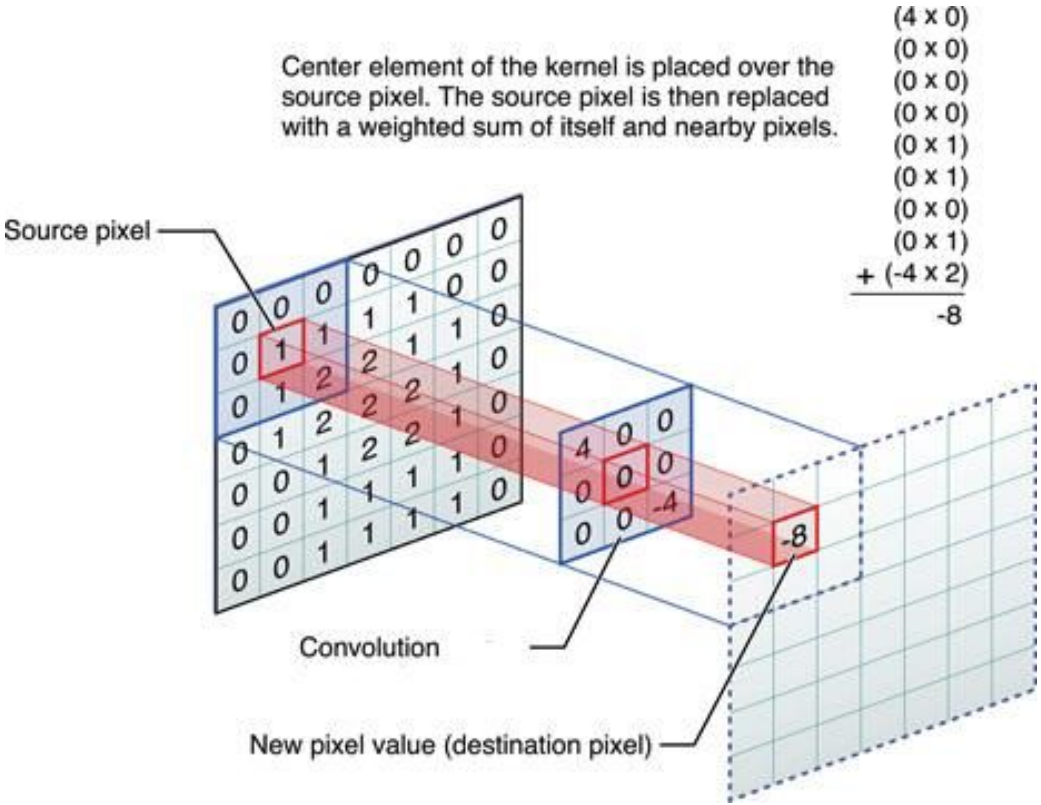


Image source: **Medium**

Filters/Kernels

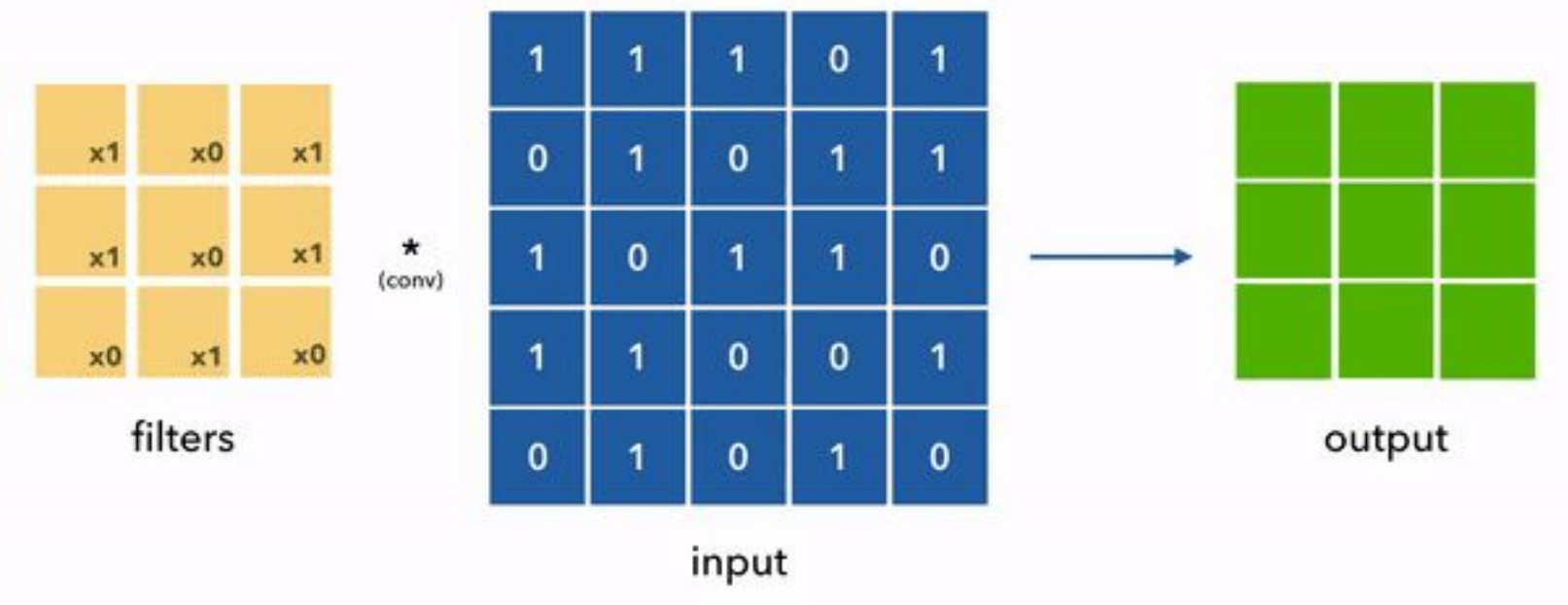


Image source: [Made with ML]

Stride

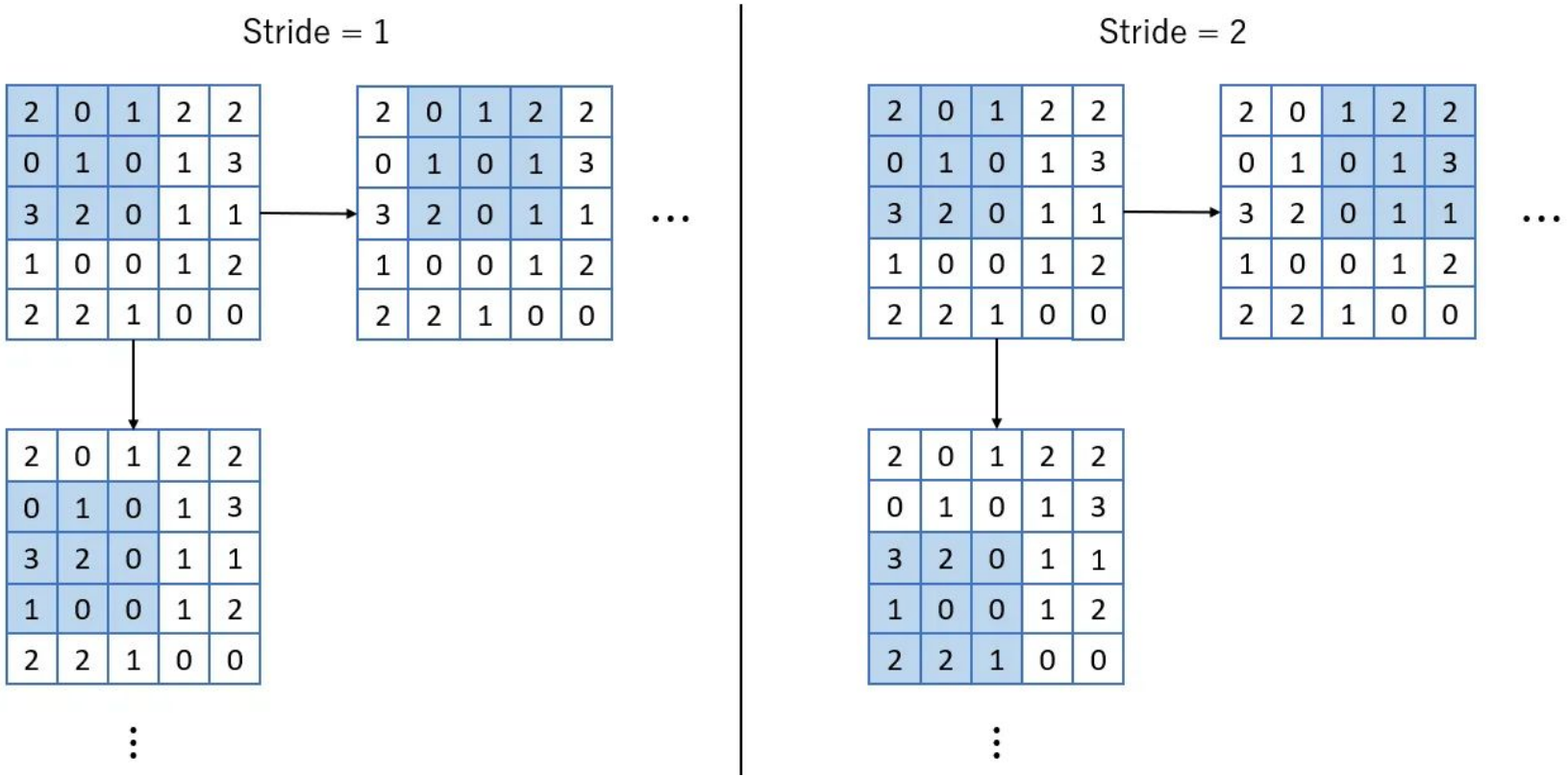


Image source: [Medium]

Pooling Layers

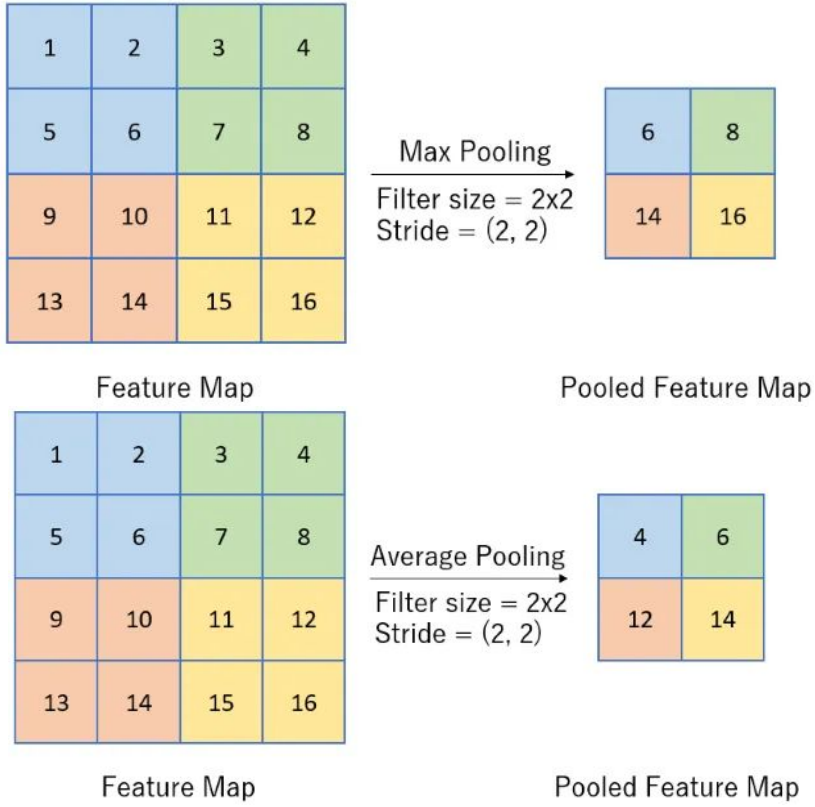


Image source: **Medium**

Fully Connected Layers

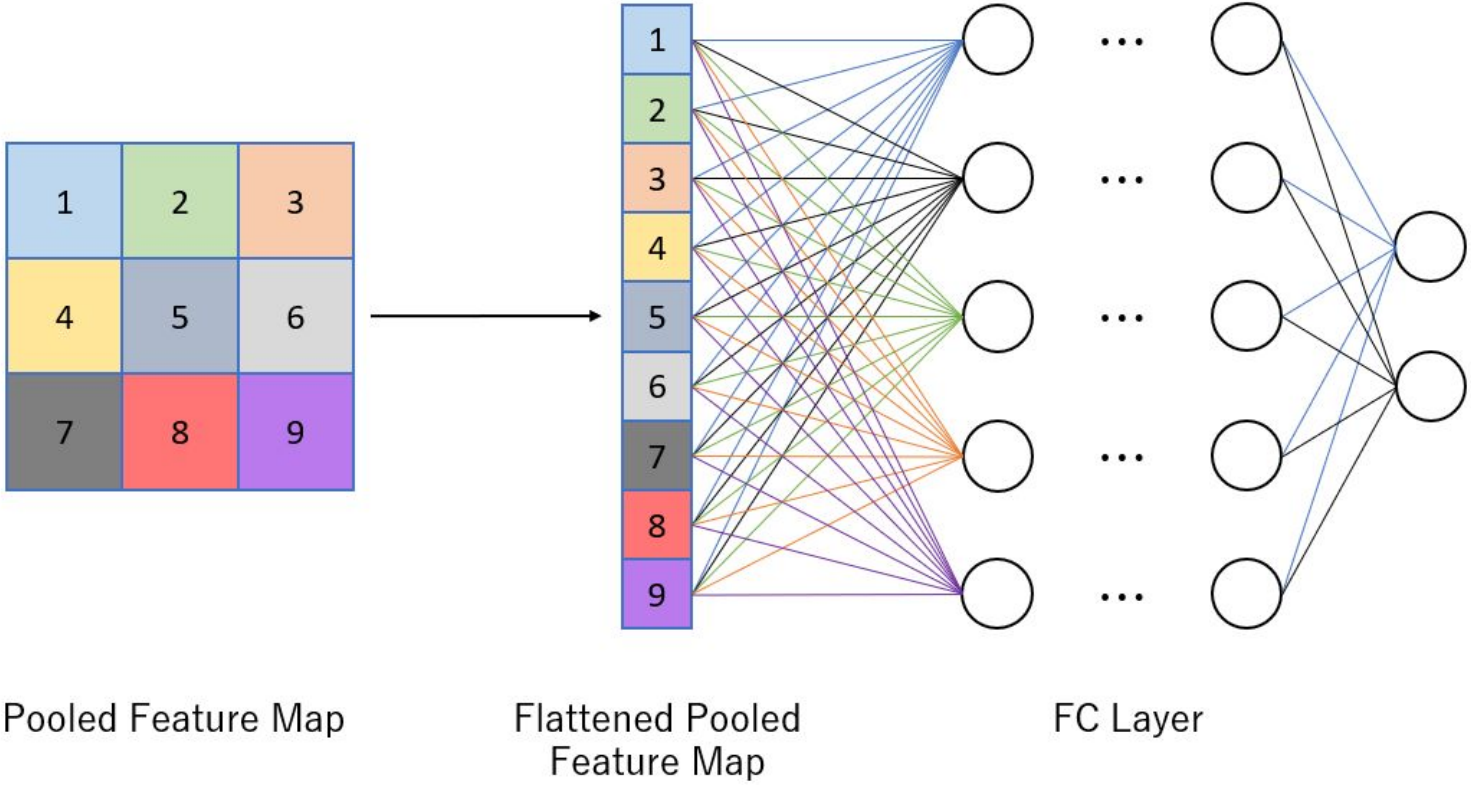
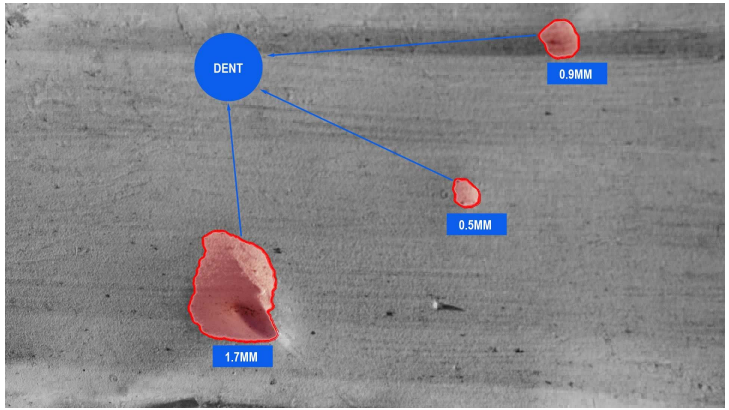
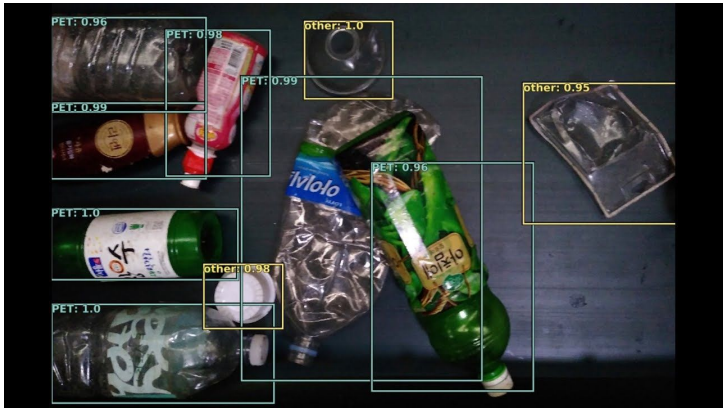


Image source: Medium

Image Classification Use Cases





Images sources: upper left, upper right, bottom left, bottom right

Swish Activation Function

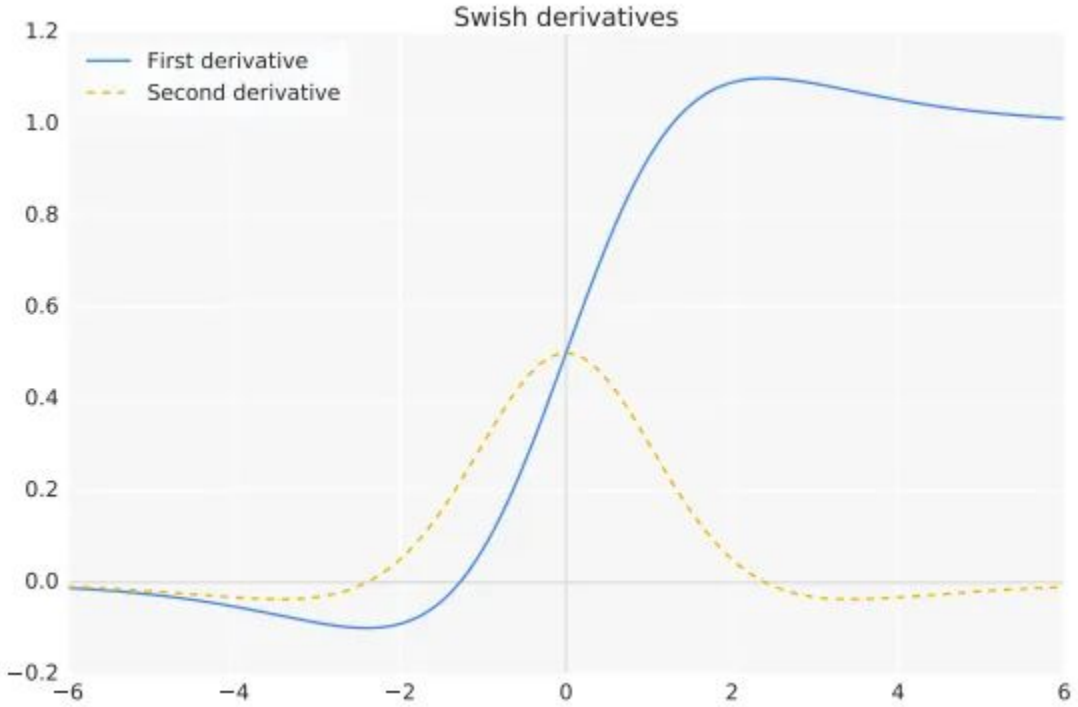


Image source: [Lazy Programmer]

Advanced Topics Preview

Complex Number-based CNNs

- Introduction to using complex numbers in CNNs
- Advantages: Improved edge detection and phase information handling

Image Segmentation

- Pixel-wise classification for detailed image analysis
- Applications in medical imaging and autonomous driving

Defect Detection in Industry

- CNNs for quality control and anomaly detection
- Importance in manufacturing processes

Common Challenges and Solutions

1. Computational Complexity with High-Resolution Images
2. Data Annotation and Labeling Challenges
3. Variability and Complexity in Image Data
4. Lack of Invariance to Geometric Transformations
5. Adversarial Vulnerabilities and Robustness

Summary and Key Takeaways

Recap:

- The structure and function of CNNs.
- Biological inspiration.
- Importance in image classification tasks.

Key Points:

- Automatic feature extraction.
- Handling of spatial data.
- Versatility in various applications.

Q&A Session

Thanks for listening and see you in the next lesson!

Next Steps

1. Let's have a Kahoot to reinforce concepts!
2. Code Session
3. Quick Overview of the Lab Assignment